LESS COMMON ELEMENTS IN FERTILIZER PRACTICE

A radio talk by Dr. Oswald Schreiner, Chief, Division Soil Fertility, Bureau of Chemistry and Soils, delivered through WRC and 39 other radio stations associated with the National Broadcasting Company, Wednesday, January 7, 1931.

Every now and then we run across some crop difficulties, which on investigation turn out to be deficiency of some element in the soil. Usually it is one of the three principal plant-food elements in the standard fertilizer, nitrogen, phosphorus, or potash, about which I told you in earlier radio talks, but occasionally we run across a peculiar soil in which some other, less common element, is the determining factor, such as manganese, a metal which is similar to iron, only its salts are pink instead of green; or copper, which you all know as the deep blue crystals used in your spray material; or boron, familiar as boric acid in baby's talcum powder and borax in your laundry soap; or zinc, or iodine or other elements not ordinarily thought of when soils or fertilizers or crops are considered.

And yet, some of these less-common elements vitally affect the health and well being; not only of plants but of animals and human beings that use them as foods.

I want to tell you about one of these peculiar soils from southern Florida, which was giving a good deal of trouble. The soil consists almost entirely of calcium carbonate, that's limestone, deposited as a fine slime from the seawater that used to cover these glades, as they are called.

This soil is used largely for the production of tomatoes and the particular difficulty was that the tomatoes wouldn't grow well and the leaves had white spots and areas between the veins. Analysis of the soil showed that the difficulty was a lack or a deficiency of this element called manganese by the chemist.

This poor growth could not be remedied with liberal applications of the ordinary standard fertilizers, but the addition of such minute quantities of manganese sulphate, as 50 pounds per acre, produced strong, vigorous plants, deep green in color, luxuriant blossoming, and greatly increased fruit production.

In fact, without manganese there is no fruit production and the plants soon fade and die. Commercial fertilizers are used in this region at the rate of two tons per acre, but with all this fertilizer the tomatoes would not grow and flourish until the missing manganese was also added.

Manganese sulphate is now used generally with the fertilizers in the area south of Miami in the growing of beets, carrots, lettuce, cabbages, corn, potatoes, beans, ornamentals and forage crops, whereas formerly these crops were considered failures on this land. All the crops grown without manganese were pale and mottled, made a poor growth and produced little or no marketable vegetables.

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The growth was very good where manganese was used and only 50 pounds were required to produce this remarkable difference in yield, the difference between success and failure in economic crop production.

But remember that manganese is widely distributed throughout the United States and most soils contain sufficient for profitable crop production, but in certain sections where manganese is rare in rocks and soils, or where conditions are such that the manganese is unavailable to plants, serious difficulties are experienced.

An interesting comment on the action and essential character of manganese has recently been made by some Australian investigators. They found that the plants might grow with the amount of manganese stored in the seed, in certain cases for weeks and that then the manganese deficiency symptoms developed with disease-like suddenness. Different plants require different amounts of manganese to enable them to complete their development. Therefore, certain types of soil, which do not possess sufficient available manganese for the growth of one kind of crop, may nevertheless support an apparently normal growth of pasture plants and weeds which, however, contain less manganese than the same plants grown on normal soil. This fact, according to these investigators may be found to have some connection with certain animal diseases which occur on these manganese deficient soils in South Australia.

There are many troublesome and little-understood plant diseases which may be directly traced in the future to manganese deficiency or to a deficiency of some other little-understood essential element. There are many so-called physiological plant diseases which have baffled the pathologists. It has been shown that the disease of oats, occurring in South Australia on certain soil types and also on alkaline soils in Germany and Sweden, is a manganese deficiency disease due to a lack of available manganese in the soil.

Another striking illustration of the effect of minute quantities of the less common plant food elements, especially of copper, occurs in the work of the Florida Agricultural Experiment Station on Everglades peat. These peat lands present many problems and among them has been the lack of response to fertilizers. There have been obtained plant growth responses on a long list of plants by using such unusual fertilizing elements as zinc, antimony, nickel, tin, barium, copper, and manganese. Of these the most favorable results were obtained with copper. By the use of copper, plant growth has been enormously stimulated, and although the problem is not yet solved, this research holds out much promise for the future of the Everglades.

The treatment of Everglade peat lands with copper sulphate has reached commercial proportions, and together with proper fertilizer use is giving very encouraging results in the practical utilization of these extensive Everglade peat lands.

Some work has also been done with boron and with zinc and this latter has also given marked results which seem to indicate that it too is essential to growth. The evidence, however, that zinc is really essential is rather conflicting in the experiments recorded in the literature, and no agricultural value can as yet be assigned to its compounds.

Boron is an admirable illustration of the principle that these rarer plant foods must be handled with care and understanding. Without boron there is no plant development, no maturation, no fruition, but excessive amounts cause damage and crop failure. Scientific control of the amounts supplied in seed, soil, irrigation water, and fertilizer are essential and show us that the old days of haphazard experimentation and practice are not possible, when these new forces and factors are brought into play.

The work done at the famous Rothamsted Agricultural Experiment Station in England with the leguminous plants not only showed the essential character of boron to plant growth, but demonstrated that in the broad bean the boron was absolutely essential in the production of the vascular system or ducts of the legume nodule which enables the plant to obtain the much needed nitrogenous matter from the nodule and in return supply sugars and other food substances to the bacteria in the nodules, thus enabling them to grow and develop and fix more nitrogen, a truly remarkable system of cooperation between plant, bacteria, and boron.

While in the island of Sumatra, of the East Indies group, two summers ago, I ran across an interesting trouble with tobacco. Sumatra, you know, is famous the world over for its tobacco leaf. The so-called disease looked like a nutritional distrubance to me and I suggested to the director of the Tobacco Experiment Station, who consulted me in the matter, that one or the other of these less common elements, like boron or manganese, etc., was in all probability responsible. The director has since advised me that total absence of boron was found to be the cause and by applying traces of this element the difficulty was entirely removed and the so-called disease eliminated.

It is not possible to review all the conflicting evidence on this question of essentialness of the chemical elements to plants and animals, but I do not want to leave the subject without pointing out to you the tremendous value to human and animal life and freedom from disease of the presence of these elements in the food we eat and the feed we give to our stock. Iodine is essential to prevent the dreaded goitre in man and abortion in cattle and hairlessness in young pigs; copper and manganese play their part in the formation of blood and the prevention of anemia and it has been shown that these constituents are wisely stored up in the unborn child or animal to enable it to function properly until it can get its own supply later in its food, since mother's milk or cow's milk does not supply these essential elements at the start. As you know, liver which contains copper compounds is now being prescribed even for pernicious anemia; low calcium and phosphorus content cause many serious diseases in cattle. Numerous other illustrations might be cited. The best and normal way for nature to supply these elements, as well as the other essential mineral elements, to animals and to man is through their feed and food, through plants, vegetables and fruits, grown on fertile well-fertilized soils.